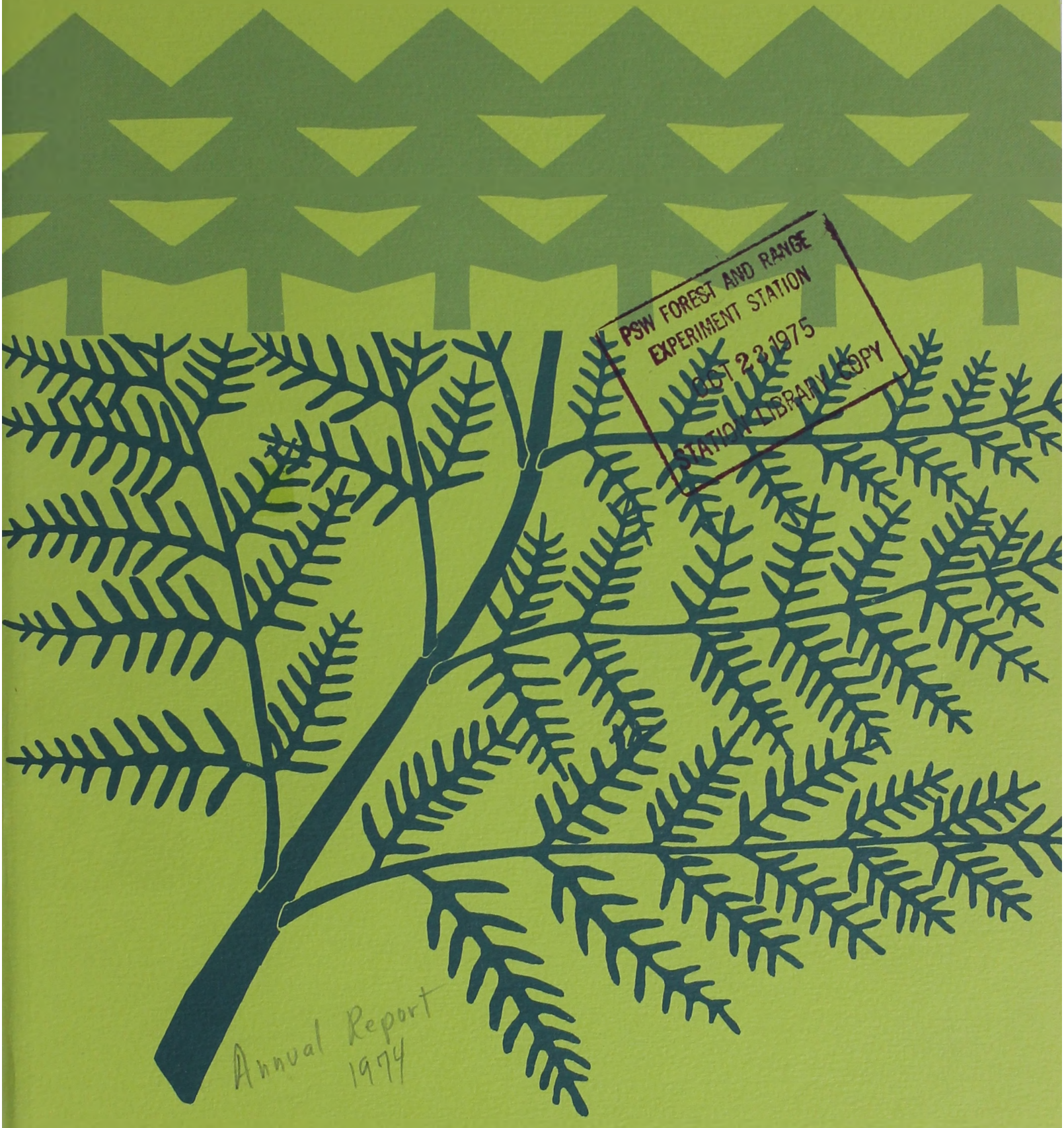
RESEARCH PROGRESS 1974



Annual Report
1974

Pacific Northwest Forest and Range Experiment Statio
U.S. Department of Agriculture Forest Servic

FROM THE DIRECTOR

Research is an orderly process—the development of new information proceeding slowly, with only occasional "leaping and soaring," a phrase coined by former Assistant Director Donald F. Flora. Mycologist James Trappe leaps and soars on page 6 of this report as we discuss his recent progress in mycorrhizae research . . . entomologist Gary Daterman on page 4 in the development of the sex attractant for Douglas-fir tussock moth . . . and meteorologist W. B. Fowler on page 16 as the inventor of a new device to measure snow density.

But you can read the report for yourself. And I hope you will. There are many new ideas and findings here that will help lead the way to new and better forestry practices in the Pacific Northwest. In some cases, you may see immediate uses for the work; in others, it may take scientists working with land managers many years to develop the necessary application techniques. We invite your suggestions in all areas of our work.

Robert E. Buckman

ROBERT E. BUCKMAN
Director

ADMINISTRATION

EXPERIMENT STATION REORGANIZED

A realignment of administrative responsibilities at the Experiment Station took effect November 25, 1974, as part of a Forest Service-wide reorganization. The move is designed to improve research planning and administration, and encourage liaison of research administrators with forest land managers and other clients.

The reorganization calls for a Director, Deputy Director, four Assistant Directors with two in charge of our 24 research units, and three Program Managers.

OTHER NEW ASSIGNMENTS

Donald F. Flora, formerly Assistant Director in Portland, is now heading a special research effort to study current timber management policies of the Forest Service and make recommendations for future action. A report will be submitted to the Chief of the Forest Service in July 1975 in time to be incorporated in the timber resource assessment required by the Renewable Resources Planning Act of 1974.

Flora has also been involved in the nationwide effort of the Forest Service to carry out the

provisions of the Resources Planning Act. This act provides for long-term planning and an inventory of all natural resources. For the Forest Service, which has traditionally conducted timber inventories, this will mean additional responsibility in inventory of recreation, range, water, wildlife, and other resources. In order to do this, new survey methods will be needed. We are already looking into the kinds of resource information required, evaluating opportunities for integrated management, and developing methods to acquire and analyze this information.

Former Assistant Director Kenneth H. Wright now heads an accelerated reserach program of the U.S. Department of Agriculture to learn more about, and find new control methods for, the destructive Douglas-fir tussock moth. This program is part of a $46.8 million research effort to control three major forest pests: the southern pine beetle, the gypsy moth, and the tussock moth.

The new program brings together the efforts of several research units of the Forest Service and participating colleges and universities. It will build on past research findings and the needs of forest land managers with special emphasis on developing: (1) methods for predicting when and where tussock moth outbreaks will occur; (2) chemical and biological insecticides; and (3) integrated control strategies that bring together several methods for keeping the insect in check.

NEW LABORATORY AT CORVALLIS

Construction continues on the east wing of the Forestry Sciences Laboratory in Corvallis. When completed, the Corvallis complex will be the second largest forestry research facility in the country, exceeded only by the Forest Products Laboratory in Madison, Wisconsin. Construction of the east wing is the fourth step in a five-stage building program for the laboratory. The three-story wood-frame and concrete structure will contain about 28,000 square feet of floor space and will include laboratories, offices, and special-purpose rooms.

FIRE DESTROYS BEND LABORATORY

Thanks to fireproof files, very little research information was lost in a $650,000 blaze that almost totally destroyed the Bend Silviculture Laboratory in January 1974. The laboratory housed ten Experiment Station employees and two with the U.S. Fish and Wildlife Service.

Fortunately, Congressional action came quickly in appropriating money to replace the facility. By October, construction was underway. Scientists, who have been working in temporary facilities, hope to move back into the new building in the fall of 1975.

NEW SCENIC-RESEARCH AREA

Interest in the headlands and estuaries of the Oregon Coast has led to the establishment of the 8,900-acre Cascade Head Scenic-Research Area in the Siuslaw National Forest. President Ford signed the bill on December 22, 1974, making Cascade Head the first scenic-research area in the country. Under this new classification, many types of recreation will be permitted, but timber harvest will be allowed only in connection with research programs or threat of forest fire, insect, or disease problems.

The Forest Service has had an experimental forest at Cascade Head since 1934. Many studies have been conducted that are related to management and protection of the very productive coastal "fogbelt" Sitka spruce and western hemlock forests of Oregon and Washington. The western portion of the experimental forest is in the newly-designated area.

More than 40 technical publications and reports have been published based on research at Cascade Head. The latest is "Checklist of the Vertebrate Animals of the Cascade Head Experimental Forest," by Chris Maser and Jerry F. Franklin, Resource Bulletin PNW-51, 1974. Based on 3 months of study in 1971 and 1972, Chris and Rita Maser identified 9 amphibians, 2 reptiles, 35 birds, and 40 mammals. Publication of the checklist helps make Cascade Head an increasingly valuable area for research and educational purposes.

NATURAL AREA NEEDS OUTLINED

Research Natural Areas are tracts of land which have been set aside for research and educational purposes. They serve as baseline areas for comparison with those influenced by man, as educational and research areas for ecological and environmental studies, and to protect gene pools for typical as well as rare and endangered organisms.

In Oregon and Washington, many organizations have been active in identifying and preserving Research Natural Areas for more than 40 years. At present, there are about 60 federal Research Natural Areas and some 25 state and private natural area preserves. In the past several years, interest in the establishment of natural areas has increased markedly, partly as a result of legislative enactment of natural area programs by the states of Washington and Oregon.

In the fall of 1973, four groups—the Pacific Northwest Research Natural Area Committee, Oregon and Washington State Natural Area Advisory Committees, and The Nature Conservancy—agreed to join in a common effort to develop a comprehensive outline for a minimal Oregon-Washington Research Natural Area system. The result is a report, soon to be published, entitled "Research Natural Area Needs in the Pacific Northwest—A Contribution to Land-Use Planning."

This report will play an important role in natural area selection and establishment for years to come. Although periodic revisions will be needed, this report represents the recommendations of several hundred people, and is a giant step forward in developing a comprehensive natural area system in the Pacific Northwest. The detailed descriptions of approximately 300 natural areas which are needed in Oregon and Washington will give long-sought guidance to those responsible for natural area programs and help in preserving critical environmental areas before they are lost forever.

INSECT CONTROL

PROGRESS IN TUSSOCK MOTH CONTROL

Forest insect problems were in the news again in 1974 as forest land managers in eastern Oregon, Washington, Idaho, and Montana fought the battle of the Douglas-fir tussock moth. Research progress continues to add to our understanding of forest insect biology and ecology, and the development of new control techniques. The development of new control methods involves a lengthy procedure, including laboratory experiments, small-scale field tests in the woods, pilot tests (usually several thousand acres), and registration by the Environmental Protection Agency, before a new insecticide can be registered for use in the forests. In many cases, there is no way to speed up the year-by-year orderly development of information.

Scientists from our Corvallis and La Grande, Oregon, laboratories have been heavily involved in this research effort. Studies have been conducted on aspects such as developing a better understanding of the biology and ecology of the tussock moth, developing improved biological controls, early warning systems, better aerial application methods, and helping to monitor the effects of DDT on wildlife and range animals.

SEX ATTRACTANT IDENTIFIED

Perhaps the most noteworthy achievement during 1974 has been the identification of the sex attractant or pheromone of the tussock moth.

This is especially important because the insect can be a very sneaky pest. It seems to be either at very low levels or in epidemic proportions, leaving entomologists no mid-way warning points. What has been needed is a sensitive sampling system which can be used easily and practically in the forests to keep track of the numbers of tussock moths present. The sex attractant should meet those needs.

Work was begun at the Oregon Graduate Center in 1973 to identify the chemistry of the attractant. During 1974, this was accomplished with the attractant identified as (Z)-6-heneicosen-11-one, a compound that has since been duplicated artificially in the laboratory. Development of field sampling techniques for the attractant is proceeding and should result in a highly efficient and economical early warning device for future tussock moth outbreaks.

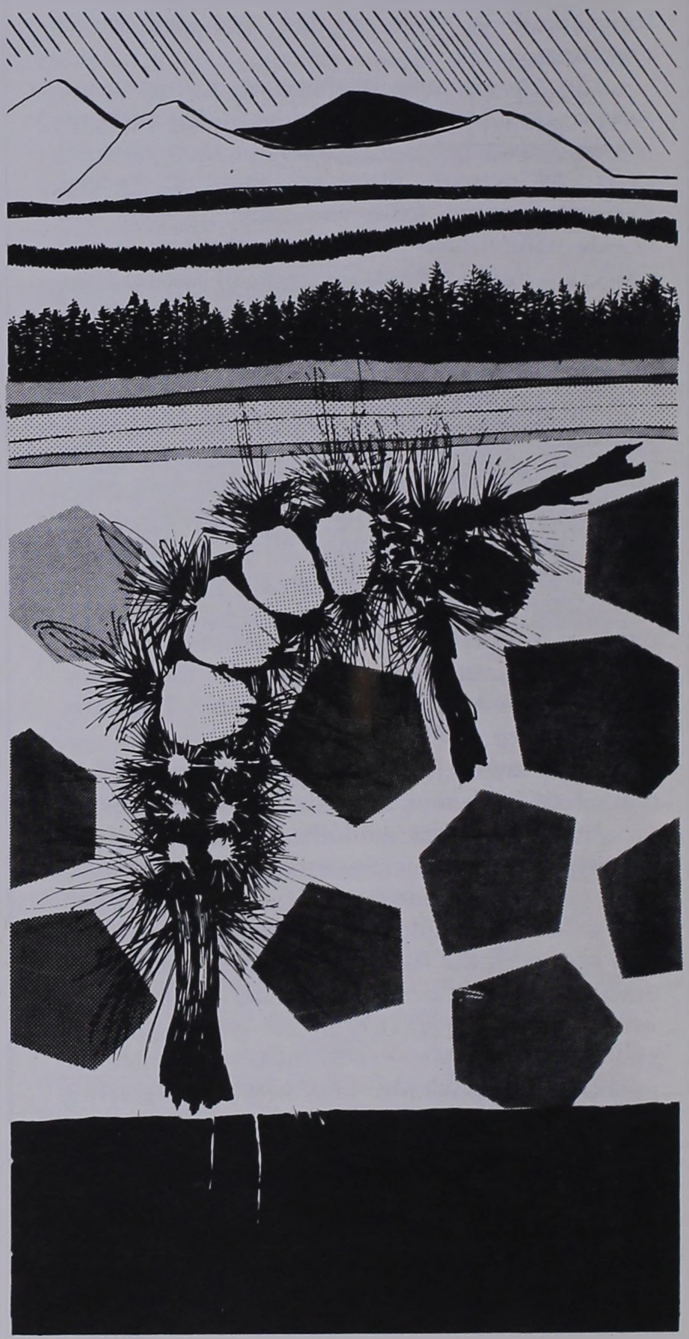
PROGRESS MADE IN INSECTICIDE TESTING

In keeping with the Forest Service's policy of developing a wide arsenal of control methods for use against the tussock moth, continued emphasis has been placed on developing new methods of chemically controlling this pest. Work in 1974 included a variety of field tests, ranging from tests on single trees to large pilot control tests of hundreds or thousands of acres. Experiments were conducted in Montana, Idaho, Washington, and Oregon.

At the request of the Environmental Protection Agency, the Forest Service conducted a series of tests to see if reduced doses of DDT would be effective in controlling this pest. It was found that 1/2 pound of DDT per acre was almost as effective in controlling this pest as the standard dose of 3/4 pound per acre. One-quarter pound per acre was almost as effective, giving 98.9 percent control of the larvae. Researchers believe it may be possible to effectively control this pest at even less than 1/4 pound per acre if better application and more uniform coverage is obtained.

As a result of other chemical experiments, it appears that Sevin-4-oil and Dylox are the most promising of several chemicals for replacing DDT in tussock moth control. Tests of Zectran, which had also been promising earlier, were dropped when the company discontinued production. One new material, Orthene, appears to be more effective than either Sevin or Dylox—at least in the small tests conducted this year. Orthene also appears to be safer to use in the environment than these two materials and DDT.

In continuing the search for new materials, tests were conducted on single trees with 15 new chemicals. Five of these appeared to be equal in effectiveness to Sevin and Dylox and two of them appear as effective as DDT.



TUSSOCK MOTH DIET STUDIED

Information on the diet preference of the Douglas-fir tussock moth is of interest to entomologists because that information might be used to predict potential damage or to recommend silvicultural treatments to prevent epidemics.

During the past year, entomologists learned some new things about the way an insect's diet affects its growth and development. In laboratory tests, insects were fed foliage of Douglas-fir, grand fir, and subalpine fir. Significant differences were noted in effects on survival, development, and egg production. For example, forcing larvae to feed on the needles of old-growth trees caused stress that increased mortality. This situation is also noted in forests under epidemic conditions. Scientists speculate that feeding stress may coincide with build-up of insect parasites and predators, and help bring about the decline of epidemics.

This information also supports the observation that epidemics can develop equally in Douglas-fir or grand fir, but that high populations are carried better in Douglas-fir, at least in the Blue Mountains. Researchers also noted that subalpine fir is occasionally eaten by tussock moth larvae, but that it will not support epidemics.

BIOLOGICAL CONTROLS PROMISING

Research is continuing on development of biological controls for tussock moths.

Large-scale pilot tests of the microbial insecticides, nucleopolyhedrosis virus, and *Bacillus thuringiensis*, which have been planned in Idaho, had to be cancelled because insect populations were lower than predicted. However, followup studies of highly successful treatments with these materials in 1973 showed the areas to be free of tussock moths and the trees pretty much recovered from defoliation.

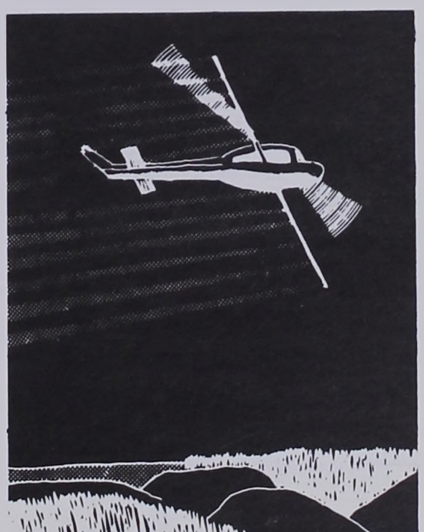
The tussock moth research program will continue from 1975 through 1977 under an expanded research and development program of two agencies of the U.S. Department of Agriculture: the Forest Service and the Cooperative State Research Service. Although there is no major epidemic in Oregon or Washington where scientists can now continue field testing of insecticides, scientists can learn much about what causes tussock moth outbreaks even when insect populations are at low levels. Current outbreaks in northwest Montana and Canada may meet needs for additional field testing.

ENVIRONMENTAL EFFECTS OF DDT NOTED

For the past several years, the Station's Range and Wildlife Habitat Laboratory at La Grande, Oregon, has been research headquarters for Forest Service and other scientists working on tussock moth problems. Scientists from this facility were also called upon to help land management organizations monitor the effects of DDT on wildlife and range animals. Results indicate no hazard to either sheep or to nestling survival of blue birds and house wrens.

Researchers are careful to note that they studied only nestling survival—not adult birds. No differences were noted in nestling survival between areas that had been sprayed and those that had not. Since only two types of birds were studied, results should not be applied to other bird species or habitat types.

A study of DDT residues in sheep grazed on sprayed forest rangelands continued for 14 weeks after spraying to determine the rate and amount of DDT residue accumulation in body tissues and organs. Rate of decline of residue content up to 18 weeks following removal from sprayed ranges is also being studied.



CASEBEARER PARASITES RELEASED

In the continuing effort to establish natural enemies of the larch casebearer in the West, scientists have released new species of insect parasites which kill this pest of larch trees. The casebearer was introduced to this country late in the 19th century and subsequently spread from the east to the west coast where it was discovered in Idaho in 1957. Since the insect is not native to this region, there are no effective natural enemies to keep it in check. The control program so far has emphasized the introduction of natural parasites which hopefully will control the casebearer naturally.

The first parasites were released in western forests in 1960. Two other species were released in 1972, and in 1973 releases were expanded to include three more genetic strains of one of these. In 1974, releases were made of four additional species including two never before released in North America. This year, stock of the most important European species was obtained. Although few of these insects were released this year, more are being reared at the Corvallis Laboratory for release next year.

FOREST DISEASES

MYCORRHIZA RESEARCH ADVANCED

Research on mycorrhizae, the symbiotic relationship of fungi with the roots of higher plants, has been advanced by a new report on the mycorrhiza-forming fungi of the family *Endogonaceae* (pronounced en-doe-go-nay-cee-ee). ("The *Endogonaceae* in the Pacific Northwest," J. W. Gerdemann, and James M. Trappe, Mycologia Memoir No. 5.) This work, completed in cooperation with the University of Illinois, will enable researchers to determine which of the 44 known species of *Endogonaceae* they are working with, or if they are dealing with a new species. These fungi, which form vitally needed mycorrhizae with nearly 95 percent of the world's plant species, could not previously be identified.

Mycorrhizae have fascinated scientists for years, and with good reason. The symbiotic, or mutually beneficial, relationships which bind fungi and plants together, are a biological continuation from earliest times. As plants evolved in primeval waters, both algae and fungi were present, but neither could make it alone on land. Together they could survive, the algae a specialist in producing chlorophyll, and the fungi scavanging mineral nutrients from the soil. Today, the soil fungi and roots still coexist, each doing its own important work. Without these beneficial fungi, most modern plants, including forest trees, could not survive.

The book on *Endogonaceae* is particularly timely as interest in reforestation and containerized seedlings has grown. Researchers are already at work to develop the methodology for inoculating nursery seedlings with beneficial fungi. This was very difficult before containerized and greenhouse planting because the soil must be sterilized first. Otherwise the beneficial fungi would be crowded out by competing, resident microorganisms.

MYCORRHIZAE CONFERENCE HELD

Experiment Station personnel were responsible for organizing and hosting the Second North American Conference on Mycorrhizae in Corvallis in August 1974. This successor to the first conference at the University of Illinois in 1969 was chaired by Dr. James Trappe, leader of a forest disease research project at the Forestry Sciences Laboratory. More than 100 scientists participated from all over the world, including the United Kingdom, Finland, Spain, Nigeria, Ghana, Pakistan, Australia, New Zealand, Mexico, and Canada. The program brought to the participants the latest information on mycorrhizal associations and news of useful applications that may help solve forest regeneration, and nutritional and root disease problems.

DISEASES IN FIR TREES STUDIED

On thousands of acres in eastern Oregon and Washington, an understory of grand and white fir has grown up under the ponderosa pine forests—the result of many years of effective fire control.

Now, when foresters cut the pine trees, there is a ready-made forest of firs to take their place. Although the firs are small—often no more than 4-7 feet tall—they may grow rapidly once the overstory is cut.

The only problem is the high risk of disease. Since the firs are fairly old (25-150 years), they are quite susceptible to infection by decay fungi. These fungi may "hole up" in the pith of stems and branches, just waiting for an opportunity to grow. An injury or change in moisture conditions may trigger the onset of a serious disease.

In an effort to evaluate the risk of disease in these fir stands, researchers conducted a study to see if decay fungi are prevalent in one area of the Malheur National Forest. More than 1,200 cultures were made from pith samples of fir trees to determine the types of microorganisms present. Fungi known to cause tree decay were isolated from 5 of the 16 study trees and unidentified fungi which may cause decay were isolated from 6 trees. Of special concern is the fact that scientists isolated the Indian paint fungus (*Echinodontium tinctorium*), a serious cause of decay in mature grand and white fir forests.

Research is continuing in an effort to determine if the area studied is typical, and to find out if latent infections develop into decay when the trees begin to grow faster following release.

SOIL FUNGI RELATED TO FOREST TYPE

Research is adding to our understanding of the relationship between red alder, forest fungi, and nitrogen in the soil. Scientists have known for some time that red alder trees are nitrogen-fixing, meaning their roots have nodules that "capture" nitrogen from the air and transform it into nitrogenous compounds that plants can absorb from the soil. This is desirable in terms of plant growth, and may help significantly in establishing the Douglas-fir forest on soils that are low in nitrogen.

Recent studies at the Cascade Head Experimental Forest on the Oregon coast indicate that microfungal populations also differ by forest tree type, just as the amount of soil nitrogen differs. In one study, researchers found that soil under pure alder stands contained 55 species of microfungi, while pure conifer stands had only 45 and a mixed forest had 46. Many of the species appear to be associated with either the red alder or conifer forest, but not with both. In addition, many of the fungi are in groups renown for antibiotic production, such as the *Penicillium* species from which penicillin is made. Microfungi with antibiotic properties may be excellent candidates for use in the natural control of root diseases of trees.

ROOT DISEASE ADVANCES SLOWLY

An infection center of the root disease *Poria weirii* increases an average of about 2 feet per year in high-elevation forests, scientists have learned. The *Poria* study was conducted in mixed conifer stands above 5,000 feet elevation in the Waldo Lake area of the Willamette National Forest in Oregon. The trees were primarily mountain hemlock with true firs, western white pine, and lodgepole pine mixed in. Spread of the disease was measured from aerial photographs taken in 1946 and 1972.

Poria weirii can be a serious problem in forest areas similar to the one studied. With the information provided, foresters managing these stands for timber production will now be able to make predictions of the damage that can be expected. Probably more important, since trees in this forest type above 5,000 feet are often of lesser commercial value, is the significance to recreation planners. Campgrounds and other recreation facilities should be located where the hazard of falling, rotten trees is minimal. A location near an expanding *Poria* center is a poor one.

GENETICS

GENETICALLY IMPROVED TREES

For many years scientists have been working on the genetic improvement of trees. The offspring of this intensive effort are now finding their way into commercial use throughout the Pacific Northwest. Within the past year, three genetically improved types of trees have been made available by Pacific Northwest Forest and Range Experiment Station researchers.

Early in 1975, 174,000 improved Christmas tree seedlings were distributed to Christmas tree growers in Washington and Oregon. These seedlings were grown from seeds produced by genetically superior parent trees which were tested throughout a full generation of tree growth. The tests have proven that the seeds are capable of producing a 10 to 20 percent gain in commercial value over untested seed.

Douglas-fir seedlings which respond well to grafting are also available now. Researchers have overcome the problems of tissue rejection in Douglas-fir by breeding a type that is highly graft compatible. The problems involved in grafting from one Douglas-fir to another are analogous to the tissue rejection problems encountered by a surgeon attempting a heart transplant. ("Genetics of Graft Rejection in Douglas-fir," Donald Copes, Can. J. For. Res. 4(2).)

Stray pollen can now be monitored from year to year in managed Douglas-fir seed orchards by using another new tree material. Pollen from inferior tree stock, from outside the orchards, can reduce the quality of the seed produced. In the past several years scientists have identified a recessive gene for albinism in some Douglas-fir trees. Grafts of these trees, incorporated into the orchards, allow foresters to monitor seed for genetic purity. These special grafts indicate the proportion of seeds fertilized from unwanted pollen sources.

GENERATION LEAPING IN GENETICS

The establishment of two second-generation seed orchards in the Willamette Valley marks a giant stride in genetically improving Douglas-fir. Plans for the seed orchards were developed by Experiment Station geneticists and are being carried out by the Vernonia Tree Improvement Cooperative, which includes the state of Oregon, Crown Zellerbach Corp., Longview Fibre Co., and International Paper Co.

These northwest Oregon landowners are using a technique which will save about 15 years in developing improved tree seed. Usually, the second step in tree improvement comes after about 15 years when parent trees (proven of high quality by growth of their offspring) are crossed to establish a new seed orchard. In the shortcut method, the crosses will be made now and poorer trees culled out later as they demonstrate their weaknesses through the growth process.

Scientists expect that by 1985, the best parents will be identified. By then the seed orchard should already be producing adequate seed for sustained needs of the 350,000-acre joint ownership in the cooperative.

SCIENTISTS BARKING UP WRONG TREE

One of the possible causes of low germination in seeds of noble fir has been studied and eliminated from further consideration. Scientists thought that self-fertilization might be a cause, but studies indicate that the same high rates of empty seed result whether from self-, cross-, or wind pollination. Self-fertilization was actually higher than for any other western conifer, with trees providing 70 percent as many sound seeds from self-pollination as cross-pollination.

TREE PLANTING CAUTION URGED

How far from its origin can a tree seed be planted before trees display the lethal or debilitating effects of poor adaptation? New information indicates that east-west transfers are far more dangerous than north-south transfers. The crucial discovery is that tree populations differ in

the threshold of the temperature required to initiate growth, and that these thresholds are related to the climate where the trees evolved. Results suggest that under no circumstance is it advisable to move seedlings from the Coast Range to the Cascades or vice versa.

FOREST RECREATION

GETTING PEOPLE INVOLVED

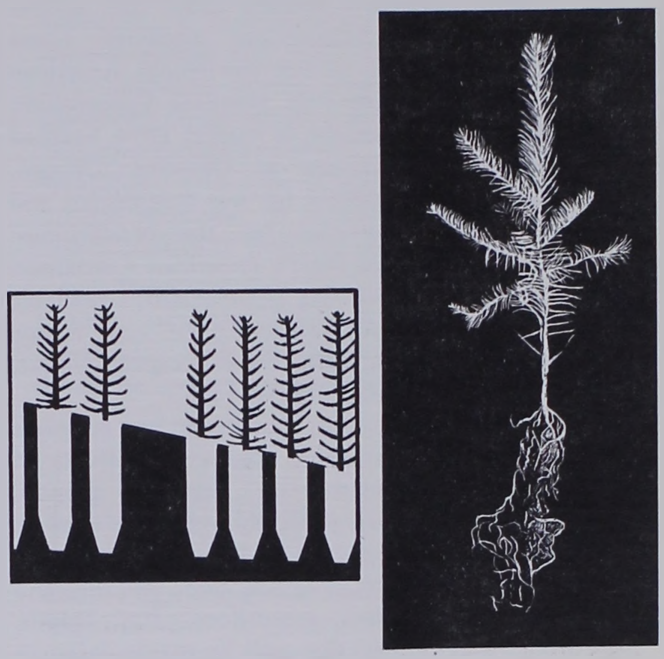
For several years, recreation researchers have been working with resource managers to develop ways to analyze written public input concerning resource management decisions. The product was the CODINVOLVE System (Research Note PNW-223), a systematic way to analyze, store, and retrieve public comments on issues of all kinds. Since its development, CODINVOLVE has been used to analyze more than 50,000 written public responses, on issues ranging from the Forest Service's national review of roadless areas and the Pelican Butte winter sports development in Oregon, to a wilderness proposal in Olympic National Park, Washington.

NEW RECREATION STUDIES BEGUN

Previous studies of hunters by the recreation research unit let to development of a new "Multiple Satisfactions Approach to Game Management," by John Hendee, Wildlife Society Bulletin 2(3), 1974. This framework, an application of sociology to game management, will be further developed and tested in a study of the satisfactions people get from elk hunting and trout fishing in Oregon.

Dispersed use of roaded forest land is a new focus for recreation research. A pilot study last summer indicated heavy dispersed use on some forest road systems—2,700 people in one drainage over Labor Day weekend taking part in a variety of activities. A series of studies is planned to identify the nature and extent of dispersed use of forest roads and how it can be integrated with other forest management activity.

FOREST MANAGEMENT



CONTAINERIZED SEEDLINGS STUDIED

Containerized seedlings are being produced and planted by the millions on forest lands in the Pacific Northwest. Yet, little is known about how well they perform compared to conventional bare-root seedlings. Procedures have now been developed for making field trials of containerized and bare-root nursery stock (Research Note PNW-222), and studies are underway.

In 1974, 27 test plots were established using container stock produced in the experimental greenhouse of the Siuslaw National Forest near Corvallis. The species include Douglas-fir, noble fir, Pacific silver fir, ponderosa pine, lodgepole pine, western hemlock, western larch, and western redcedar. Early results indicate that in some cases first-year survival was substantially better for containerized seedlings. But under some circumstances survival of bare-root seedlings was better. True firs and hemlock appear to benefit most from being grown in containers. Additional plantings will be made and performance data collected for several years in order to develop guidelines for use of containerized and bare-root stock.

CONTAINERIZED PLANTING SYMPOSIUM

Many questions remain about the proper conditioning of containerized seedlings. These needs were evident during the North American Containerized Forest Tree Seedling Symposium, held at Denver, Colorado, in August 1974. Staff of the Experiment Station at Corvallis, Oregon, helped plan the program for this symposium and provided several articles for the proceedings. ("Proceedings of the North American Containerized Forest Tree Seedling Symposium," available from the Rocky Mountain Forest and Range Experiment Station, 240 West Prospect Street, Fort Collins, Colorado 80521.)

In addition, studies have begun in a cooperative effort to learn more about the effects of environmental control on seedling growth. Douglas-fir, ponderosa pine, noble fir, and western hemlock will be grown under three different simulated seasons, representing high, normal, and moderate temperature conditions. Day length, watering, and fertilization will be manipulated to determine the effects on hardening seedlings for frost resistance.

WOODY PLANT SEED MANUAL PUBLISHED

Knowledge about the seeds of trees and shrubs has been compiled for the first time in 30 years in a new book, "Seeds of Woody Plants of the United States" (USDA Agriculture Handbook No. 450). Seventeen scientists from the Experiment Station contributed several man-years to the compilation of this 885-page book.

The new publication replaces the "Woody Plant Seed Manual," which was published in 1948 and has been out of print for several years. The 1974 book is twice as large and has several improvements. It contains complete literature citations for each of eight sections on seed biology, and principles and methods of producing, handling, and germinating seeds. A separate section gives seed data and specific handling methods for approximately 800 species among 188 genera of woody plants. The new book places greater emphasis on illustrations, many of which were provided by the Station's technical photographer, Wally C. Guy.

The book is for sale only and may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402, stock no. 0100-02902, at a cost of $13.50.

RESIDUE COMPENDIUM PUBLISHED

A major report published in 1974 is the state-of-knowledge compendium on forest residues, edited and organized by Owen P. Cramer. This is the largest report yet published by the Experiment Station (556 pages) and a cooperative effort of PNW scientists representing 15 disciplines.

The report is a comprehensive survey of the effects of forest residues and their treatments on nutrient cycling, water quality, regeneration, aesthetics, and other parts of the forest environment. It is intended as a knowledge base from which forest managers may develop improved residue management practices. Practical guidelines for residue management, based on the compendium, are now in preparation. Copies of the compendium are for sale only, and may be purchased for $6.20 at the Government Bookstore, 915 Second Avenue, Seattle, Washington 98174. When ordering refer to stock no. 0101-00389.

Forest residue use on the Pacific Coast has increased by about 1 million tons a year since 1968, mainly because of domestic and foreign demand for fiber products. This trend, reported in General Technical Report PNW-29, is expected to continue with growing needs for energy and fiber.

RELEASE OF CONIFERS PRACTICAL

New studies show that it is now possible to use chemical sprays to control competing varnishleaf ceanothus and bracken fern and release young tree seedlings for more rapid growth. ("Releasing Douglas-fir from Varnishleaf Ceanothus," H. Gratkowski and P. Lauterbach, J. Forestry 72(3).) Well-stocked stands of young Douglas-firs are often found under dense overstories of varnishleaf ceanothus. But the ceanothus retards tree growth by shading the trees and robbing the soil of valuable moisture. In tests on small plots, growth of trees released by sprays of 2,4,5-T was 1.7 to 2.5 times that of comparable trees under unsprayed ceanothus.

Western bracken fern often forms a dense cover along rights-of-way and on forest and range lands. Until recently, there was no way this species could be controlled. Studies now indicate that a spray of 3 pounds per acre of asulam will produce a 92-percent reduction in bracken cover for at least 2 years. Asulam, a carbamate herbicide, will not damage Douglas-fir if applied in August after the trees have stopped growing.

NITROGEN SPRAYS INCREASE GROWTH

Forest fertilization is becoming a practical method for increasing tree growth. In the past decade, more than one-half million acres have been fertilized in the Pacific Northwest. Most of this has been with granules of nitrogen fertilizer dropped by helicopter or airplane. Spraying nutrient solutions on tree foliage is an alternative method with some potential advantages.

A series of experiments, begun in 1969, indicate that foliar sprays can provide growth response in Douglas-fir and hemlock similar or greater than those provided by urea granules at low to moderate nitrogen doses. Foliage samples collected 1 and 3 months after fertilization showed greater and more rapid uptake of nitrogen and improved needle color from foliar sprays. However, high doses of concentrated sprays damaged foliage and offset the beneficial effects of treatment. This type of application requires more critical selection of chemicals and dosage, and closer control of fertilizer distribution.

There are several advantages of liquid application, not the least of which is that most herbicides and insecticides are also liquid and could be applied at the same time.

AUTOMATED TIMBER HARVEST DESIGN

A major advancement in logging design technology has been achieved following recent improvements in programmable electronic desktop calculators, digitizers, and plotters. Research engineers in Seattle have developed computer programs to automate timber access road and harvest unit planning and design.

This not only changes design techniques, but provides an entirely new approach to logging planning. Today's logging engineer, with suitable electronic tools, can now rapidly analyze any possible timber harvest setting, and evaluate road design alternatives, including projected road locations, horizontal and vertical alignments, and earthwork quantities at a rate of up to 1,000 feet of road per minute. This makes it possible to consider all reasonable design alternatives in the search for the best possible design to meet today's ever-increasing environmental and economic constraints.

Use of this new technology has been accelerating since it was first presented at the Skyline Logging Symposium in Seattle, January 1974. Proceedings of that symposium plus several new reports on computer applications in logging design are now available.

CHEMICALS IN STREAMS

One of the principal concerns in the use of chemicals in forestry is with the compounds getting into streams. This is particularly true of fertilizers, fire retardants, herbicides, and seed-protective coatings.

Twenty-seven sites have been monitored in the Pacific Northwest, and two in Alaska, to determine the effect of nitrogen fertilization on water quality. There appears to be no problem at this time. Losses of nitrogen into the streams at these locations were less than one-half of 1 percent when buffer strips were left along main streams and tributaries.

Studies of fire retardants in streams are in the second year of a 3-year program and not yet published. Early results indicate that contamination can be avoided if the retardants are not released directly over streams. Information is also available on contamination of streams by the pesticide Endrin, commonly used to treat forest tree seeds. Detectable residues were reported in streams for up to 11 days in some cases, but concentrations were well below the tolerance limits for important fish species.

OXYGEN DEMAND HIGH

Oregon State University scientists working on a grant from the Experiment Station recently completed studies of the effect of Douglas-fir tree needles and debris on oxygen levels in forest streams. Debris of this type is common in small mountain streams after clearcutting. ("Biochemical Oxygen Demand of Finely Divided Logging Debris in Streamwater," Stanley L. Ponce, Water Resources Research, Vol. 10.)

The toxicity of these materials to guppies and steelhead trout proved very low, but oxygen depletion is a more serious problem, particularly during periods of low water flow.

REFORESTATION

REGENERATION IN UPPER-SLOPE TYPES

Management of upper-slope tree species is becoming increasingly important. But foresters should proceed with caution. Forest regeneration is a special problem in these high-elevation timber types. Although seed crops may frequently be good (Research Note PNW-213), seedling distribution and survival both present considerable problems.

In one study in the southern Oregon Cascades, Jerry F. Franklin and Clark E. Smith found that natural regeneration is a major problem in mountain hemlock following clearcut logging. Even in an abundant seed year, seedfall declined rapidly beyond one tree height from the timber's edge (Research Note PNW-214). In a companion report, Franklin and Smith point out a similar problem in white and Shasta red fir. Shelterwood harvest or elongated clearcuts oriented northwest-southeast may help solve the problem for the firs (Research Note PNW-215).

In another study of seedling establishment and survival in grand fir and mountain hemlock, authors K. W. Seidel and R. Cooley found that mortality of both species was heavy in a shelterwood cut: 71 percent of the fir and 90 percent of the hemlock died (Research Note PNW-229). But regeneration success depended on the number of trees left in the shelterwood. As stand density increased, more seedlings of both species were established and survival of fir improved.

RESEARCH IN ALASKA

INTERIOR ALASKA RESOURCES SOUGHT

The scramble for natural resources worldwide has focused attention on the renewable and nonrenewable resources of arctic and subarctic Alaska. Because of Project Independence, the primary interest has been on oil, gas, and coal resources. However, foreign interests are increasing their efforts to exploit Alaska's subarctic forests. Thus, there is an expanding market for interior Alaskan timber, especially white spruce saw logs.

The Institute of Northern Forestry, in cooperation with the Bureau of Land Management and the Alaska Division of Lands, has been conducting a study on the Bonanza Creek Experimental Forest to examine the effects of the clearcut and shelterwood silvicultural systems on the natural regeneration of white spruce and associated species. The study is also investigating the effects of these two harvest methods on other resources and the natural environment.

Results so far indicate that adequate natural regeneration can be obtained under both systems—if sufficient mineral soil is exposed during logging or by seedbed preparation following logging. Associated studies indicate that solar radiation and temperature conditions, important to seedling growth and establishment, are substantially different between these two systems. But their effects on seedling growth and development in this cold-dominated environment remain to be assessed.

BLACK MOTH ATTACKS PAPER BIRCH

An epidemic of the spear-marked black moth erupted in 1974 and spread through 2 million acres of paper birch forests in interior Alaska. The only other recorded epidemic occurred in 1957 and 1958, but little information was collected then on the biology and ecology of this defoliator. Experiments are now underway to determine the cause of the epidemic; the effect of extreme low temperatures on insect survival; and the effect of parasites, predators, and pathogens on the epidemic population.

Natural control agents identified so far include a granulosis virus, three fungi, a bacterium, and eight species of parasites. Female moths were also found to produce a sex attractant which induced mating behavior in males. Methods have also been developed to break the overwintering quiescent stage so that mating and egg laying by the adult moth can progress in the laboratory during the winter months.

ALASKA ENVIRONMENT PROBLEMS

Much of our research in Alaska is related to environmental protection. Studies are aimed at learning more about the natural ecology and at reducing the impact of land use practices on the environment. Reports published during 1974 include studies of the effects of log dumping and rafting in southeast Alaska, the toxicity of the herbicide 2,4-D to young salmon, smoke conditions due to wildfire in interior Alaska, and the use of log skidders over crawler tractors for fireline construction. See the bibliography for references on these topics.

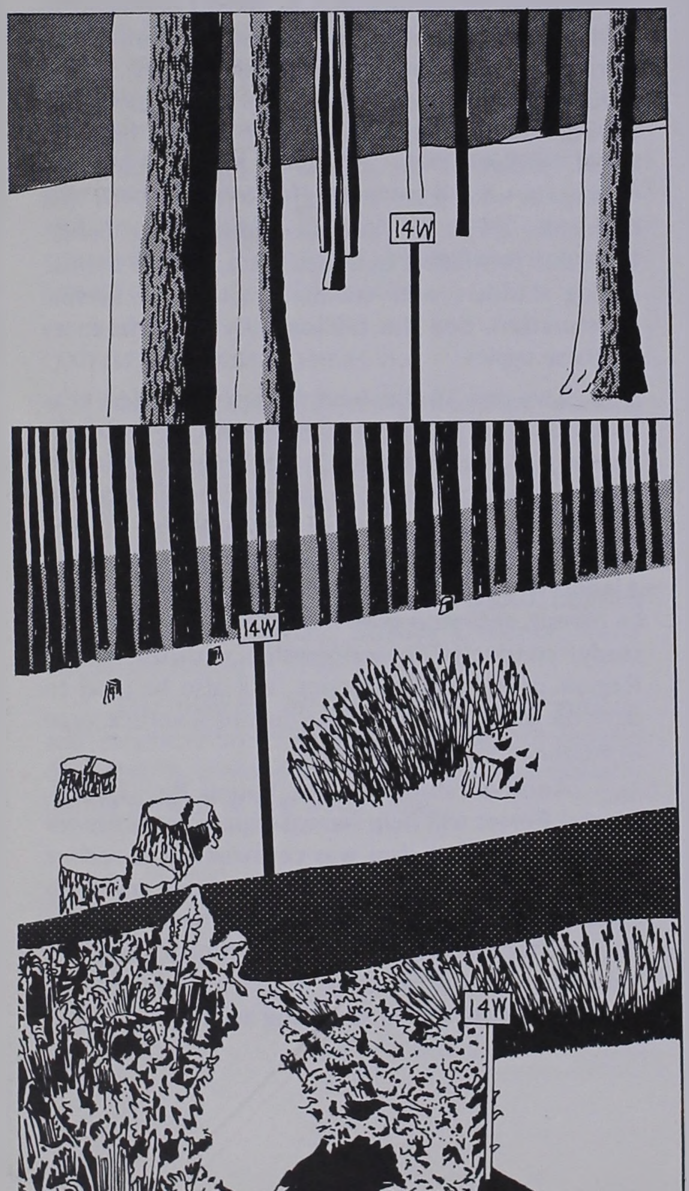
Two new studies were initiated this past year by the staff of the Forestry Sciences Laboratory in Juneau, Alaska. Scientists have begun a study of timber stand density to assess the effects of thinning on timber stand development in the western hemlock-Sitka spruce forests of coastal Alaska. In this region, trees are often too crowded to permit optimum growth and development. This study, conducted in cooperation with the Alaska Region of the Forest Service, will also be used to develop yield tables for the hemlock-spruce type in Alaska.

Another study in the Young Bay Experimental Forest will help increase spawning areas for salmon. A gabion dam was constructed to reduce the gradient of the stream and allow gravel to collect for fish spawning. Researchers hope to develop techniques to create additional spawning areas for salmon in those types of streams that have very little natural spawning area.

SOUTHEAST ALASKA REPORTS

A series of reports, "The Forest Ecosystem of Southeast Alaska," will provide forest managers and users of forest resources with the most complete information available for making decisions about the use and protection of forest resources. Eight reports are available now, with a total of ten planned in the series.

Reports already published include: 1. The Setting; 2. Forest Insects; 3. Fish Habitats; 4. Wildlife Habitats; 5. Soil Mass Movement; 6. Forest Diseases; 7. Forest Ecology and Timber Management; and 8. Water.



FOREST SURVEY AND ECONOMICS

TIMBER IN OKANOGAN COUNTY'S FUTURE

An analysis has been made of future timber supplies and their expected economic impact for Okanogan County, Washington. Researchers found that timber outputs cannot be substantially increased over the next three or four decades without reducing future forest production. Timber supplies are projected to decline slightly by the year 2020. Employment in forest industries is projected to decline about 60 percent, but forest industrial payrolls by only 27 percent. Publication is expected in 1975.

BLUE MOUNTAINS CHANGING

Foresters are aware that forests are not static, but constantly changing with or without man's influence. A study of timber resources in northeastern Oregon revealed many changes since a previous study in the 1950's. For example, sawtimber volume in the eight-county region decreased 10 percent. The inventory of ponderosa pine, historically the most important species, declined 20 percent, but supplies of Douglas-fir, true fir, and lodgepole pine increased. Commercial forest area decreased about 25,000 acres while noncommercial juniper stands increased by 90,000 acres, invading overgrazed rangeland mainly in the southern Blue Mountains. The area in productive sawtimber decreased while nonstocked forest land increased. The publication is expected in 1975.

DOUGLAS COUNTY STUDIED

Many communities and local governments in the Pacific Northwest are extremely dependent on timber as a resource base. This is true of Douglas County, Oregon, where the economy is about two-thirds based on timber. Since timber harvest in that area is based primarily on old growth, cutting from private lands is expected to decline within the next 10 to 20 years.

To help local industries and governments make better decisions about the county's economic well-being, researchers have prepared a report which identifies the role of timber and timber-based industries in the economy (Research Paper PNW-179).

Using an input-output technique, economists evaluated the effect on various local industries of such things as: change in demand for forest products; change in Forest Service or Bureau of Land Management appropriations; changes in timber harvest in private and federal ownerships; and a decline in private harvest offset by an increase in harvest from federal ownerships (Forest Service or Bureau of Land Management). The study is valuable primarily as an aid to resource planners in Douglas County or to other local governments who might want to see how changes in local timber harvest would affect their communities.

ESTIMATING SITE PRODUCTIVITY

In last year's report, we announced development of a new technique to estimate the stocking capacity of forest land—particularly on forest sites that are too hot and dry to support full stands of timber.

Now researchers have taken this work a step further and developed stockability equations for five geographic areas in California (Research Note PNW-233). Stocking capacity is determined by three factors: site index, physical characteristics of the land, and the presence of indicator plants. The equations can be used to identify areas that are not capable of supporting "normal" stocking. Such information is extremely important in estimating potential timber yield from the poorer producing timber sites. In the past, use of standard yield tables (generally based on average or better forest sites) for these poorer locations may have led to overoptimistic estimates of future timber yield.

VOLUME EQUATIONS DEVELOPED

New volume equations have been developed for seven California conifer species: Douglas-fir, ponderosa pine, white fir, sugar pine, California red fir, lodgepole pine, and incense-cedar. Separate equations have been developed for cubic-foot volume, International 1/4-inch board-foot volume, and Scribner board-foot volume. The new equations will provide a useful supplement to existing Scribner volume tables. Publication is anticipated in 1975.

TIMBER RESOURCE STATISTICS

Forest Survey reinventories are planned at intervals of 10 to 15 years. With a rapidly changing resource situation, this interval is sometimes too long to meet the needs for current data. As a result we have now issued updated inventory statistics for the states of Washington and Oregon. The reports are available as Resource Bulletin PNW-50 (Washington) and Resource Bulletin PNW-56 (Oregon).

TIMBER RECOVERY DATA PUBLISHED

Several new reports from the Experiment Station outline the potential of timber of various ages and species to produce lumber or veneer. Publications are now available on veneer recovery for second-growth Douglas-fir (Research Paper PNW-173), old-growth coastal Douglas-fir (Research Paper PNW-174), and red and white fir in California (Research Paper PNW-171). Results of research on lumber recovery from second-growth coastal Douglas-fir in Oregon (Research Paper PNW-177) and for Engelmann spruce in Arizona (Research Paper PNW-170) have also been reported.

Researchers are putting special emphasis on learning more about the potential yield of standing dead and small diameter trees. These timber types have largely been ignored as a wood resource, yet there is a considerable amount of wood available in these classes. Researchers are currently studying yields of very small live and dead lodgepole pine (down to 2-1/2 inches in diameter) and dead white pine in Idaho, young-growth ponderosa pine in California, cull western hemlock logs in Alaska, and white fir damaged by the tussock moth infestation in northeastern Oregon.

Studies are also underway to identify differences in the amount and type of forest residue developed from skyline, balloon, and helicopter logging as part of the Pansy Creek aerial logging demonstration in the Mt. Hood National Forest of Oregon.

INSULATION HELPS REDUCE NOISE

Two current studies are yielding valuable information about how to conserve heat and reduce noise in wood-frame houses. Research shows that mineral wool of full thickness (about 3 inches) will reduce heat loss by about 25 percent when installed between studs in exterior walls. When mineral wool is used in conjunction with resilient fasteners for the interior wall surface, sound transmission is also reduced considerably. In laboratory tests, the noise from traffic or aircraft was reduced by one-half. Resilient channels are used to attach and separate the interior wall from the framing material, and help control sympathetic vibration of the interior and exterior surfaces.

Windows are usually the weakest part of the exterior wall—at least where heat loss and sound transmission are concerned. Tightly fitted storm windows help reduce both heat loss and sound transmission by about one-half.

WATERSHED STUDIES

STUDIES YIELD VALUABLE DATA

Studies in the Entiat Experimental Forest, badly burned by fire in 1970, continue to provide valuable information about the effect of wildfire on forested watersheds. The biggest change scientists have found is in the responsiveness of the watershed to rainfall or snowmelt. Basically, the buffering effect of the forest environment has been destroyed. Peak water discharge rates have gone up from 9 cubic feet per second in 1966-67, to a maximum of 19 cubic feet in 1971-72.

Soil temperatures and stream temperatures also increased after the fire. Soil temperatures are high enough in charcoal-covered areas that it would be difficult to revegetate artificially with trees because of the extremes in daily temperatures.

On the positive side, nitrate nitrogen increased sharply, but not enough to affect water quality for drinking purposes under the current standards of the Environmental Protection Agency. Stream turbidity is also much greater during spring snowmelt than before the fire, but that is expected to decrease as natural and planted vegetation gradually covers the slopes.

SOIL CREEP MEASURED

Landslides, soil slumps, and other erosional processes do not "just happen." They are the result of natural long-term gravitational stresses that cause a slow, downslope movement of the soil mantle. This movement, sometimes called soil creep, can be accelerated by road construction, logging, or other land management activities.

A study begun last year is now yielding data on rates of soil creep in the Pacific Northwest. Scientists at the Forestry Sciences Laboratory in Corvallis have measured creep rates in 17 inclinometer holes in the western Cascades, the Oregon Coast Range, and the Coast Range of northern California. Creep is determined by drilling a hole in the ground down to bedrock, inserting a flexible tube, and measuring the changes in the shape of the tube with a device called an inclinometer.

First-year data from the western Cascades indicates that creep rates range from .2 to .4 inch per year in deeply weathered pyroclastic materials. Movement occurred primarily during the rainy season. Continuing studies will teach us much about the natural factors that contribute to severe erosion problems—for example, soil type, soil water content, topography, and geology.

For a summary of erosion problems in the western United States, forest managers may want to study General Technical Report PNW-21, "Slope Stability Problems Associated with Timber Harvesting in Mountainous Regions of the Western United States," by D. N. Swanston.

SNOW MEASURING DEVICE DEVELOPED

To help in his work at the Wenatchee Forestry Hydrology Laboratory, meteorologist W. B. Fowler has developed a small, pencil-like probe to measure snow density. It costs less than $1.00, a bargain at today's prices! The device can be inserted at any depth in the snowpack to take a single, manual reading, or can be left in place throughout the season. If a manual reading is all that's needed, this probe should do the job. If the scientist wants to measure snow density throughout the winter, however, additional meters and recording systems would be necessary, upping the cost considerably to hundreds of dollars.

For additional information write or call:

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